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ABSTRACT

The COMPS course is a basic introductory computer course taken by first year Computer Systems students. Eighteen students took the course with Computer Assisted Instruction (CAI), while the rest of the students took the course in the conventional classroom setting. Although there was no difference between the two groups' mean group performance scores, the CAI students on the average required only 80% of the time required by the other students to complete the course. Other aspects of the course discussed include examination of the mastery model, summary of student attitudes, associated costs, and recommendations. (VT)

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RIR-78-2

A SUMMATIVE EVALUATION OF THE CAI COURSE "COMPS"

by
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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

January, 1978

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COMPS EVALUATION

BACKGROUND:

The CAI course called COMPS (COMPuting Systems) was designed by Dallas Hauge, an instructor in Computing Systems at the Northern Alberta Institute of Technology (N.A.I.T.), Edmonton. In 1975, Mr. Hauge spent six months at the Division of Educational Research Services (DERS), Faculty of Education, University of Alberta during which time he designed and implemented the course on the DERS CAI Facility.

The initial test of the course was held in September of 1976. For the most part, the course was well accepted by the students and few problems with the course code were encountered. Since the course made use of a number of graphic illustrations, these materials were redesigned, photographed and made available on computer addressable coloured film. Some minor revisions were made to the course code during the fall of 1976 and the course was "officially" offered to students from N.A.I.T. in September of 1977.

Adequate terminal time was reserved for the computer systems students from N.A.I.T. during the two weeks from September 12th through September 23rd, 1977. This time period included three days per week with two hour blocks available each of the days. The times reserved were from 8:00 a.m. - 10:00 a.m. Since the students were required to travel to the CAI Facility at the University of Alberta campus, they met on the N.A.I.T. campus at approximately 7:15 a.m. each of the designated CAI days for a bus trip to the University campus. Following each CAI session, the students again took the 30-45 minute ride back to the N.A.I.T. campus. Even with the constraints of requiring at least 90 minutes extra for the bus trip to and from the

CAI Facility, there were few complaints from the students.

COURSE DESCRIPTION:

The COMPS course is a basic introductory computer course. The course was taken by first year Computer Systems student's beginning in the first week of their first academic term.

Because the course was implemented on an IBM 1500 CAI system, some of the terms used to describe the course are the same as those used in describing certain components of the IBM 1500 System.

The COMPS course was divided into four basic segments (chapters). Each segment was preceded by a pre-test and followed by a post-test. Students were not permitted to advance from one segment to the next segment until they scored at least 80 per cent on the segment post-test. Below is a brief description of each course segment.

Segment	Description
10	Introduction to computer components.
15	System/360 storage concepts.
20	System/360 assembler language coding concepts.
25	Basic instructions necessary to code a short assembler program.
99	Glossary of computer terms.

TIME REQUIREMENTS:

Although there was a total of 12 hours of computer time reserved for taking the course, the average time for the 18 CAI students to complete the course was slightly less than eight hours (see Table 1). In addition, eight hours of classroom laboratory time was provided. Thus the CAI students took 16 hours to complete the course requirements. The time taken by students who took the course in the conventional classroom setting was approximately 20 hours. Thus the

CAI group required 20% less time to complete the same course requirements.

TABLE 1
MEAN TIME REQUIRED TO COMPLETE COMPS

SEGMENT	MEAN	LOW	HIGH
10	1:32	0:28	2:19
15	2:21	0:54	3:25
20	2:01	1:02	2:54
25	1:38	0:22	2:11
99	0:17	0:01	0:31
TOTAL =	7:49		

FINAL TEST RESULTS:

Approximately two weeks after both groups of students (CAI and Conventional) completed the course unit requirements, a common written final examination was administered to all students. In order to compare the final scores of the conventional-instruction group with the final scores of the 18 CAI students, a random sample of 18 scores was selected from the pool of 100 scores in the conventional group. A t-test of the two sets of 18 scores was conducted. The results of the t-test, summarized in TABLE 2, indicate there was no difference between the mean group scores. That is, the CAI group performed as well as the conventional group. However, in interpreting the results one must bear in mind that the CAI students, on the average, required only 80% of the time required by the students who took the classroom instruction.

TABLE 2

t-TEST OF BETWEEN GROUP DIFFERENCES ON THE FINAL EXAM

	CAI	Conventional Instruction
N	18	18
$\bar{X}$	73.06	71.78
S	18.51	23.11

$t = 0.183$

$p \leq 0.859$

EXAMINATION OF THE MASTERY MODEL:

The instructional model adopted for this course is often referred to as the mastery-based model. In COMPS, when a student enters a segment (chapter) he/she is first presented with a pre-test. In the case of COMPS, each segment pre-test consisted of 10 questions. Each question was associated with a particular instructional objective. If the student correctly answers all 10 questions he/she was automatically transferred to the next unit in the course. If the student answered eight or nine of the pre-test questions correctly he/she was only required to take instruction in the sections that were answered incorrectly and then permitted to transfer to the next unit of instruction. Students who correctly answered less than eight questions were required to take instruction in the entire segment and then required to take a post-test.

Students were not permitted to advance to the next segment of instruction until they were able to correctly answer eight of the 10 post-test questions. For example, if a student correctly answered only five of the 10 post-test questions, he/she would then be required to retake the instruction in the five topics that were incorrectly

answered in the post-test. After retaking the instruction, the student would then be presented with the questions that were incorrectly answered on the first attempt of the post-test. The students were required to continue retaking the material until a cumulative sum of eight questions were correctly answered in the segment post-test. Although one student repeated sections of segment 25 at least seven times, every student attained the 80% criterion-level in all segments of COMPS.

The pre-test and post-test scores for each segment were examined to see if the students did indeed learn the required material in their first pass through each segment. A dependent sample t-test was applied to the pre-test and post-test scores in all course segments of COMPS. The analysis, shown in TABLE 3, indicated that at the 0.01-level of significance, there was a difference between the pre- and post-test scores for each segment in the course. That is, the post-test scores were significantly higher than the pre-test scores. It is interesting to note that on the first attempt, the mean post-test scores were near or above 80% for all segments of COMPS, except segment 15. Examination of TABLE 4 indicates that segment 15 stood out as the one segment in which fewest students achieved the criterion on the first attempt.

TABLE 3

SUMMARY RESULTS OF t-TESTS OF SEGMENT PRE-TEST AND POST-TEST SCORES

Segment	Mean		t
	Pre-Test	Post-Test	
10 (n=19)	3.263	8.789	6.910*
15 (n=18)	2.353	6.824	6.781*
20 (n=18)	2.833	7.833	9.119*
25 (n=18)	3.444	7.889	6.297*

*the probability of each t occurring by chance is less than 0.01.

TABLE 4

NUMBER OF STUDENTS FAILING TO MEET 80 PERCENT CRITERION ON POST-TEST ON FIRST ATTEMPT

Segment	Number	Percent
10	1	6
15	9	50
20	5	28
25	4	22

A further breakdown of the post-test questions is included in TABLE 5. Using the data from TABLE 5, it is recommended that in the next phase of course revision and optimization, those items be examined in which six or more students incorrectly answered the question to ascertain why the instruction associated with that question did not lead to success on that question. If one accepts the arbitrary criterion that at least two-thirds of the students must answer each question correctly, then segment 10 can be left unchanged, seven questions require modification in segment 15, two questions in segment 20, and two questions in segment 25.

TABLE 5

NUMBER OF INCORRECT RESPONSES TO POST-TEST ITEMS ON THE FIRST ATTEMPT

Segment	Items									
	1	2	3	4	5	6	7	8	9	10
10	2	3	2	1	2	2	0	0	1	1
15	1	6*	0	8*	6*	7*	3	7*	7*	9*
20	4	7*	5	2	0	16*	1	1	3	1
25	3	3	10*	2	7*	2	2	0	1	1

*the instruction associated with this question requires examination and modification.

SUMMARY OF STUDENT ATTITUDES TOWARD COMPS:

A summary of the attitudes of the N.A.I.T. students toward their course (COMPS) and CAI is included in Appendix A. Examination of the student attitudes indicates that, in general, the N.A.I.T. students were positively oriented toward both the COMPS course and CAI. For example, in question #9, only 17% of the students felt that it would have been easier to learn the COMPS material by means of classroom instruction than by CAI. In question #4, only one person indicated that he/she would not like to take other courses via CAI. The N.A.I.T. student attitudes toward CAI when compared with those of other students who had taken CAI courses at the DERS CAI Facility in the fall of 1977 indicated that generally the N.A.I.T. students were at least as positive toward both their course material and CAI.

ASSOCIATED COSTS:

Although there are a number of aspects related to the direct costs of using CAI, this evaluation will only focus upon the costs associated with implementing an operational course at the DERS CAI Facility. The cost figures listed below are the ones obtained from the DERS cost accounting system. The costs include the activities associated with any of the personnel and the hardware charges during the implementation and test periods.

YEAR	DESCRIPTION	COST
1975	Coding, input, and debugging of the COMPS code	$ 935.75
1976	Class test of COMPS and associated performance analysis	548.71
1977	Production of film and graphics	250.00
	Use of Computer System by class and associated performance analysis costs	513.82
		$2,258.28

Other costs such as consultation with the course author, initial performance analyses, costs of using the computer at the University of Alberta Computing Services, and overhead expenses are not included in the above figures. In addition, the costs associated with any N.A.I.T. related activities are not included. It should be noted that much of the above expenses are related to the initial "start-up" costs.

RECOMMENDATIONS:

It would appear that the objectives of the study were achieved. The basic aim was to permit staff from N.A.I.T. to design and implement a CAI course which could possibly be incorporated in one of the ongoing courses and to examine the cost, benefits and problems associated with implementing CAI materials. Although the total course material produced fell short of replacing an entire course, the material that was produced did as good a job, from the point of view of student learning, as is currently being done in the current computer systems course.

The most encouraging part of the study was the very positive attitudes of the students toward the course material and CAI. Since at this point in time the course still needs some revisions and a few optimization cycles the course has potential because it is already permitting the students to learn at least as much material, in less time, as in the conventional classroom.

One drawback to the mode in which the study was conducted was that the students were required to spend a great deal of time travelling to and from the University of Alberta campus. If this mode of study is to be continued, or indeed other CAI studies funded, there should be provision made for terminals to be located at the campus where the students take their courses. By housing the CAI terminals at N.A.I.T.,

for example, the students would then be able to use the terminals at times other than those scheduled for the class. In addition, local terminals would permit course authors to demonstrate their courseware to their colleagues to expose them to the concept of CAI and also to permit others to criticize the courseware.

APPENDIX A

N.A.I.T. STUDENT ATTITUDES
TOWARD COMPS AND CAI

(1) Generally, I found the noise level in the terminal room to be:

	Very Noisy 1	2	3	4	5	6	Quite Acceptable 7
NAIT		1 (6)*		1 (6)	2 (11)	3 (17)	11 (61)
OTHERS	1 (1)	4 (2)	8 (4)	16 (8)	27 (14)	54 (28)	83 (43)

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(2) I found the course was useful in helping me learn the material.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT			1 (6)	2 (11)		7 (39)	8 (44)
OTHERS	1 (1)		3 (2)	8 (4)	29 (15)	66 (34)	85 (44)

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(3) The material in this course was:

	Very Boring 1	2	3	4	5	6	Very Interesting 7
NAIT			1 (6)	3 (17)	2 (11)	6 (33)	6 (33)
OTHERS	1 (1)	2 (1)	3 (2)	20 (10)	39 (20)	68 (35)	60 (31)

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*The number in parenthesis indicates the percentage of students from NAIT (or OTHER) that fall into each category. If the percentage for NAIT (or OTHER) are summed across categories, the result should be 100 percent.

(4) This material was easy to understand.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT			1 (6)	1 (6)	11 (61)	3 (17)	2 (11)
OTHERS		7 (4)	23 (12)	18 (10)	63 (33)	56 (29)	26 (13)

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(5) What portion of this material had you been taught previously?

	None 1	2	3	4	5	6	All 7
NAIT	8 (44)	4 (22)	1 (6)	2 (11)		2 (11)	1 (6)
OTHERS	47 (24)	55 (29)	38 (20)	27 (14)	14 (7)	9 (5)	3 (2)

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(6) Generally, someone was available in the terminal room to help answer my questions about this course.

	Strongly Disagree 1	2	3	4	5	6	Strongle Agree 7
NAIT				1 (5)		5 (28)	12 (67)
OTHERS	3 (2)	7 (4)	7 (4)	12 (6)	24 (12)	61 (32)	79 (41)

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(7) Someone who is knowledgeable of the course content should be available in the terminal room.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT					1 (6)	1 (6)	16 (89)
OTHERS	1 (1)	2 (1)	6 (3)	16 (8)	25 (13)	36 (19)	107 (55)

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(8) When the course lecturer or assistant was in the terminal room, I felt that person did a good job in answering my questions.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT					3 (17)	2 (11)	13 (72)
OTHERS	2 (1)	1 (1)	2 (1)	9 (5)	26 (13)	61 (32)	92 (48)

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(9) It would have been easier to learn this material by classroom instruction rather than by computer-assisted instruction.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT	6 (33)	3 (17)	3 (17)	3 (17)	2 (11)	1 (6)	
OTHERS	72 (37)	45 (23)	28 (15)	25 (13)	13 (8)	6 (3)	4 (2)

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(10) Taking this course was a good investment of my time.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT				2 (11)	3 (17)	1 (6)	12 (67)
OTHERS	1 (1)	2 (1)	5 (3)	12 (6)	31 (16)	41 (21)	101 (52)

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(11) I would recommend this course to other students or educational personnel.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT				2 (11)	2 (11)	3 (17)	11 (61)
OTHERS	1 (1)	2 (1)	5 (3)	13 (7)	24 (12)	50 (26)	98 (51)

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(12) I would rate the difficulty level of this course as being:

	Very Easy 1	2	3	4	5	6	Very Difficult 7
NAIT	1 (6)	2 (11)		7 (39)	3 (17)	5 (28)	
OTHERS	4 (2)	9 (5)	19 (10)	43 (22)	69 (36)	38 (20)	11 (6)

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(13) I liked taking this course via Computer-Assisted Instruction.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT		1 (6)		1 (6)	4 (22)	2 (11)	10 (56)
OTHERS	1 (1)	3 (2)	3 (2)	9 (5)	28 (14)	55 (27)	94 (49)

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(14) I would like to take other courses via Computer-Assisted Instruction.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT		1 (6)		3 (17)	2 (11)	3 (17)	9 (50)
OTHERS	3 (2)	4 (2)	4 (2)	18 (9)	31 (16)	44 (23)	89 (46)

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(15) The time scheduled for taking this course on the computer was a convenient time for me.

	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
NAIT	1 (6)	2 (11)		3 (17)	2 (11)	3 (17)	7 (39)
OTHERS	7 (4)	6 (3)	4 (2)	13 (7)	25 (13)	58 (30)	80 (41)

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(16) How many hours of Computer-Assisted Instruction do you think is just right during any one sitting.

1. Less than 30 minutes.
2. 0.5 - 1.0 hours.
3. 1.0 - 1.5 hours.
4. 1.5 - 2.0 hours.
5. 2.0 - 2.5 hours.
6. 2.5 - 3.0 hours.
7. More than 3 hours.

	1	2	3	4	5	6	7
NAIT			3 (17)	10 (56)	4 (22)	1 (6)	
OTHERS		3 (2)	35 (18)	79 (41)	44 (23)	24 (12)	8 (4)